



Factors affecting the Internet behaviour of horticultural growers in Flanders, Belgium

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ARTICLE INFO

Article history:

Received 28 November 2008

Received in revised form 28 August 2009

Accepted 11 September 2009

Keywords:

Adoption behaviour

Horticulture

Human factors

ICT

Internet

ABSTRACT

Horticultural growers in Flanders make low use of the Internet. The Internet applications used most frequently are online banking, information on market prices and yields of outputs, and weather forecasts. However, a large variation of the Internet behaviour is observed among the growers. The influence of personal characteristics (biographical and social characteristics, communication behaviour) and business size is examined on the use of five groups of Internet applications: general applications, basic management information, specialised management information, information on output prices and yields, and e-commerce. Data were collected at 163 horticultural businesses with Internet use for business purposes. Categorical principal component analysis of the explaining variables resulted in five dimensions. "Openness and active search for information" shows a significantly positive influence for all examined Internet applications, except for e-commerce. "Long-term perspectives of the business" is found to have a significantly positive influence on the use of general applications and e-commerce. E-commerce is also significantly influenced by the "attitude towards risks and environmentally friendly production techniques" and "agricultural or horticultural education, supplemented by additional courses". "Larger businesses with the search for specific advice" is a dimension with a significantly positive effect on the use of specialised management information and e-commerce. For many Internet applications the personal attitudes of the business manager seem to be important, suggesting that developing human capital is crucial to increase the speed and coverage of Internet adoption.

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1. Introduction

Information use is becoming a critical factor in the changing competitive environment of horticultural growers. The importance of the Internet is growing, both as a source of information and as a vehicle for transactions. It is likely that businesses working outside this system will lose competitiveness (Gloy and Akridge, 2000; Rolfe et al., 2003; Smith et al., 2004; Taragola et al., 2001; Taragola and Gelb, 2005; Taragola and Van Lierde, 2007a,b). The Internet is increasing the perceived value of computer use, and can be associated with improved management (Michailidis, 2006). Recent research on ICT adoption reveals that in developed countries the main question is not anymore if a computer with Internet access is available, but rather which applications are used (Roskopf and Wagner, 2005; Taragola and Gelb, 2005; Taragola and Van Lierde, 2007a). According to the census of 15 May 2005, 2845 (92.4%) of the 3110 horticultural holdings with a computer have an Internet connection (Taragola and Van Lierde, 2007b; Van Lierde and Taragola, 2008). Researchers have found that farmers' and horticulturists'

personal and business characteristics strongly influence their adoption of computers and the Internet (e.g. Amponsah, 1995; Austin et al., 1998; Batte et al., 1990; Batte, 2005; Bonny, 1992; Gelb et al., 2004; Gibbon and Warren, 1992; Gloy and Akridge, 2000; Iddings and Apps, 1990; Jarvis, 1990; Michailidis, 2006; Ortman and Stockil, 1998; Putler and Zilberman, 1988; Smith et al., 2004; Taragola and Gelb, 2005; Taragola and Van Lierde, 2007a,b; Taragola et al., 2001; Van Lierde and Taragola, 2008; Warren, 2002a,b, 2003, 2004; Warren et al., 1996, 1999, 2000). However, there is little research on how these characteristics influence the use of various Internet applications. The benefits of Internet access will be determined by the use of the Internet, and not by the fact of Internet access alone. The benefit of this technology may best be measured according to usage. Usage generally determines how much value individuals derive from ICT in general (Verstegen and Huirne, 2001; Nuthall, 2004) and from the Internet in particular (Goldfarb and Prince, 2007). Although the adoption of a personal computer is virtually necessary to start using the Internet, as a technology the Internet has many characteristics that differentiate it from the PC (Gloy and Akridge, 2000). For instance, a personal computer is frequently used to process the internal data of the company, while the Internet helps the business manager to acquire and analyse external data and information. The Internet is also a convenient way for busi-

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ness managers to communicate and transact business with buyers, suppliers, specialists and other business managers.

The objective of the research is to better understand the factors influencing the use of Internet applications for business purposes in horticulture located in Flanders (northern Belgium). In order to stimulate Internet use, it is important to know which factors influence the use of various Internet applications. More in particular the influence of personal and business characteristics on the use of different Internet applications is examined.

2. Theoretical framework

Cyert and March (1963) were the first to describe the importance of search behaviour as a step in the decision-making process. They argued that information is not given but has to be obtained; that alternatives are searched for and discovered sequentially. In the search process, the environment is scanned for information that can be formulated into relevant alternatives.

A variety of factors influence the use of information. Several researchers have attempted to uncover relationships between managerial and farm characteristics and the use of information (Driver and Onwona, 1986; Ford and Babb, 1989; Schnitkey et al., 1992; Ortmann et al., 1993; Gloy et al., 2000; Alvarez and Nuthall, 2006). The managers' characteristics can be subdivided into biographical characteristics such as age, education level and so on, and social characteristics such as personal values, attitudes, objectives and communication behaviour.

Age and education are related to a decision-maker's ability to create value from the information gathered. Schnitkey et al. (1992) argue that age is related to farming experience, and that farmers with more experience should have less demand for external information. However, according to Ford and Babb (1989) more experienced farmers relied more on extension services for information about cropping decisions than younger farmers. Kool et al. (1997) show that input suppliers were more likely to have established relationships with older producers. Because the Internet is a relatively new information source, one can expect that older producers will be less familiar with it and probably will trust it less, resulting in lower use of Internet applications. Following Gasson and Errington (1993), the presence or absence of a successor may have more influence upon decision-making than the farmer's age. One can expect that at companies with a successor more use will be made of Internet applications than at those of the same age without a successor. Higher levels of education are expected to be positively related to the use of Internet applications, and should be consistent with an increased ability to process information. Education should also influence the usefulness of the most sophisticated information available. Internet use can also be seen as an innovation, and according to the innovation diffusion theory, adoption of innovations is positively influenced by education (Rogers, 1995). Education and knowledge have a dynamic character. Development of new knowledge happens only through a continuous learning process (Lei et al., 1996). Formal training should therefore be supplemented with additional training. According to Smith and Miner (1983) "opportunistic entrepreneurs" have complemented their technical education with education on business management, entrepreneurship, languages, and the like. One can assume that formal education and additional training will have a positive influence on Internet use.

The influence of attitudes on behaviour is described in the Theory of Planned Behaviour, developed by Fishbein and Ajzen (1975) and expanded by Ajzen and Madden (1986). This theory is based on the assumption that human beings are usually quite rational. An attitude is a disposition to respond favourably or unfavourably to an object, person, institution or event (Kim and Hunter, 1993).

According to Rogers (1995), earlier adopters of innovations have a more favourable attitude towards change than later adopters. They are also better able to cope with uncertainty and risk than later adopters. Research on Scottish farmers' decision-making (Willock et al., 1998) revealed that environmentally oriented behaviour was significantly correlated with environmental objectives and the psychological variables of extraversion, intelligence, information gathering, an open and innovative personality, and a negative attitude towards the use of chemicals. In the research cited, the environmentally friendly farmer is the most innovative while retaining the traits of openness, information seeking and conscientiousness typical of business farmers. One can thus expect that managers with a positive attitude towards environmentally sound production techniques will make more use of Internet applications in general, and particularly for seeking information about environmentally friendly production methods.

Communication behaviour, according to Rogers (1995), is also related to the adoption rate of innovations. Earlier adopters seek information about innovations more actively than later adopters. They have more contact with change agents than later adopters, have more social participation, and are more connected through interpersonal networks. Given the above, one can expect that socially open managers that actively search for information through seminars, extension services, study clubs, agricultural magazines and the like, will also make more use of Internet applications.

On the basis of the literature cited above, the following hypotheses can be formulated.

Hypothesis 1. Internet use will be influenced by the business manager's personal characteristics. Age will negatively influence Internet use, while the following will have a positive influence: education, positive attitudes towards openness, risk, and environmentally friendly production, and open communication behaviour (including attendance at seminars and membership in study clubs and working groups).

Hypothesis 2. Internet use will be influenced by the size of the business. We expect that business size will be positively related to the use of Internet applications. Rogers (1995) stated that earlier adopters have larger units than later adopters. One reason for this is that large firms are normally able to derive greater benefit from the costs of information acquisition. Most of the researchers found that farm size was positively related to attitudes towards and use of information sources (Ford and Babb, 1989; Schnitkey et al., 1992; Ortmann et al., 1993).

3. Methodology

In 2005, we surveyed 208 horticultural businesses that are all members of the Flemish farm accountancy data network (FADN). Sixty-four of them specialised in glasshouse vegetables, 31 in open-air vegetables, 71 in ornamental plants, and 42 in fruit production. The sample consists of professional businesses with a dimension of at least 4 Standard Gross Units (S.G.U.). One S.G.U. corresponds to a Standard Gross Margin (S.G.M.) of 5380 Euro (Taragola and Van Lierde, 2005). The FADN accountant receives business data on paper, so the business manager does not need to own a personal computer for that purpose. In 2005, we performed face-to-face interviews with 208 firm managers, resulting in a response rate of 100%. An advantage of using the FADN is that it tracks data on business characteristics (structural data, economic data, etc.) and personal characteristics of the firm manager (age, education level, etc.). This information was also used in our survey.

Of the 208 business managers, 189 (91%) owned a personal computer. In the sample the adoption of a personal computer was positively related to business size and the business manager's level

of education (Van Lierde and Taragola, 2008). These findings agreed with published data (Batte et al., 1990; Bonny, 1992; Putler and Zilberman, 1988; Warren et al., 2000). The business manager's age was found to have a negative impact, which was also consistent with other findings (Batte et al., 1990; Warren et al., 2000).

Only 173 businesses, or 83%, are using their personal computer for business purposes. Business managers without PC cite the following as important reasons not to use one in their business: "lack of technical proficiency", "too hard to use/unfriendly" and "fear of technology". In contrast, the managers that have a PC but do not use it for business cite "lack of understanding how to benefit from the various ICT options" as their most limiting factor (Taragola and Van Lierde, 2007a). These results concur with scientific results of the EFITA questionnaires (European Federation for Information Technology in Agriculture). These results indicate a shift over time in the limiting factors from ICT technical proficiency towards lack of understanding how to benefit from the various ICT options (Gelb et al., 2004; Gelb and Parker, 2005; Gelb, 2008).

Of the 173 businesses with a business PC, 163 of them (94%) use the Internet for business purposes. In total, 78% of the businesses surveyed use the Internet for business purposes. The typical company in our sample is a professional firm with a dimension of at least 4 S.G.U. that keeps accounts. The agricultural census of 2005 reports 3538 horticultural businesses that conform to these criteria. Of these businesses, 2677 (76%) have a personal computer for business purposes, which is close to the 83% observed in our survey. Of the 2677 businesses with a computer, 93% have an Internet connection, which is again very close to the percentage found in our survey. These data show that our survey represents the sub sample for the same characteristics within the total population of horticultural businesses. The businesses in our survey that used the Internet for business purposes were given a list of 20 different Internet applications. For each application, we asked them to indicate their actual use on a five-points Likert scale from 1 (if the application is never used) to 5 (if the application is very often used). As several Internet applications are interrelated during use, a principal component analysis (PCA) was performed. PCA analyses the structure of the interrelationships (correlations), by defining sets of variables that are highly interrelated, known as principal components. These groups of variables, that are by definition highly interrelated, are assumed to represent dimensions within the data. Principal component analysis assists in the construction of summated scales by identifying the dimensionality of the variables, which then form the basis for the composite values (Hair et al., 2006). Principal component analysis of the 20 Internet applications resulted in 5 dimensions, suggesting that 5 summated scales should be constructed.

The survey also contained questions on personal characteristics of the firm manager (biographical characteristics, social characteristics, and communication behaviour) and structural characteristics of the horticultural business (the economic dimension). Biographical characteristics of the firm manager included the age and education level of the firm manager and the presence of a successor. If the firm manager had taken additional courses, these were also taken into account. Social characteristics expected to be important were the attitudes towards risk, environmentally friendly production and openness of the firm manager. These attitudes were measured by proposing a certain number of theses to the managers (see Appendix A). Based on the scores for each of the theses, we created three attitude variables.

In total, 16 variables were used to clarify the use of the various Internet applications. Given that the number of clarifying variables is rather high, and that many of these variables are correlated, we reduced the variables for these businesses. Most of the variables are categorical variables. We thus used the procedure of categorical principal component analysis (CATPCA), which resulted in five

dimensions. The resulting dimensions were introduced in a regression analysis for each of the applications. In this way, we could test the hypotheses.

4. Results

4.1. Use of Internet applications for business purposes

4.1.1. Principal component analysis

Principal component analysis (PCA) of the Internet applications with varimax orthogonal rotation resulted in five dimensions with an eigenvalue larger than 1. The total variance explained by these factors is 61.21%, which in social sciences is generally regarded as satisfactory (Hair et al., 2006). Table 1 shows the factor loadings of the Internet applications on the five dimensions identified. The first dimension shows high factor loadings for the Internet applications "Information on prices of plant protection products" (0.760), "Information on prices of fertilisers" (0.742), "Information on prices of installations and machinery" (0.661), "Information on technologies for reduction of environmental impact" (0.598), "Information from government" (0.594) and "General management information" (0.554). A non-exclusive relation with Dimension 1 can also be observed for the Internet applications "Information on reduction techniques for use of plant protection products" (0.563) and "Information on reduction techniques for use of fertilisers" (0.487), which also show high factor loadings on factor 2. The Internet applications with high factor loadings on the first dimension are related to the consultation of information for general management purposes; this dimension is called "Basic management information".

High factor loadings for the Internet applications "Paid websites on horticulture" (0.734), "Information on techniques to reduce fertiliser use" (0.667), "Information on techniques to reduce plant protection products" (0.639) and "Information on recruitment of personnel" (0.605) are obtained for the second dimension. Most of these Internet applications are related to the collection of specialised management information. We thus assigned this dimension the label "Specialised management information".

The third dimension shows high factor loadings for the Internet applications "E-commerce: publicity for own products" (0.857), "E-commerce: selling of outputs" (0.826), "Promotion and advertisement on Internet" (0.791) and "E-commerce: buying of inputs" (0.535). These Internet applications with high factor loadings on the third dimension are all related to the use of e-commerce; this dimension is thus called "E-commerce".

The fourth factor shows high factor loadings for the Internet applications "Information on output yields" (0.903) and "Information on output prices" (0.890), and is called "Information on outputs".

The fifth dimension, which explains the minor part of the total variance, is mainly determined by the variables "Weather forecasts" (0.693), "Online banking" (0.640), "Warning systems for diseases" (0.550) and "Information from research institutes" (0.515). As weather forecasts and online banking are the most popular Internet applications (see Table 2) it is not surprising that they both have high factor loadings on the same dimension. In Flanders, the warning systems for diseases are organised by the research institutes. This explains the high factor loadings of the Internet applications "Warning systems for diseases" and "Information from research institutes" on the same dimension. Both applications also have a high factor loading on Dimension 2, "Specialised management information" (0.467). The fifth dimension is called "General applications".

For each of the five dimensions a summated scale was created by combining all of the variables with high factor loading on the dimension, and the average score for the variables was used as a

Table 1
Factor loadings for the principal components of the use of Internet applications (varimax rotation).

Variables	Dimension				
	1	2	3	4	5
Information on prices of plant protection products	0.760	0.164	0.116	0.152	−0.087
Information on prices of fertilisers	0.742	0.114	0.200	0.224	0.012
Information on prices of installations and machinery	0.661	−0.200	0.097	0.039	0.268
Information on technologies for reduction of environmental impact	0.598	0.389	−0.013	−0.040	0.235
Information from government	0.594	0.193	−0.097	−0.032	0.232
General management information	0.554	0.257	0.189	0.208	0.190
Paid websites on horticulture	0.043	0.734	0.062	−0.028	0.060
Information on techniques to reduce fertiliser use	0.487	0.667	0.076	0.048	0.067
Information on techniques to reduce use of plant protection products	0.563	0.639	−0.009	−0.017	0.072
Information on recruitment of personnel	0.127	0.605	0.224	0.137	0.029
E-commerce: publicity for own products	0.083	−0.012	0.857	−0.170	0.050
E-commerce: selling of outputs	0.069	0.046	0.826	−0.022	−0.044
Promotion and advertisement on Internet	0.184	0.036	0.791	0.024	−0.014
E-commerce: buying of inputs	−0.041	0.287	0.535	0.095	0.169
Information on output yields	0.176	0.044	−0.030	0.903	0.036
Information on output prices	0.110	0.095	−0.062	0.890	0.155
Weather forecasts	0.219	0.084	0.042	−0.126	0.693
Online banking	0.086	−0.132	0.231	0.269	0.640
Warning systems for diseases	0.138	0.390	−0.126	0.140	0.550
Information from research institutes	0.107	0.467	−0.067	0.308	0.515
% of variance explained	16.66	12.93	12.89	9.96	8.78

Factor loadings in bold are >0.50.

replacement variable in further analyses. One benefit of the summated scale is its ability to represent the multiple aspects of a concept in a single measure (Hair et al., 2006). In order to test the reliability of the summated scale, the internal consistency reliability was verified by Cronbach's alpha. This measure of reliability focuses on the internal consistency of the set of items forming the scale. Cronbach's alpha is the average of all possible split-half coefficients resulting from different ways of splitting the scale items. The coefficient varies from 0 to 1, and a value of 0.6 or less generally indicates unsatisfactory internal consistency reliability (Malhotra, 1999). The results reveal that the Cronbach's alpha values for each of the five dimensions were greater than 0.6. The Cronbach's alpha value was 0.79 for the first dimension "Basic management infor-

mation", 0.74 for the second dimension "Specialised management information", 0.77 for the third dimension "E-commerce", 0.87 for the fourth dimension "Information on outputs" and 0.61 for the fifth dimension "General applications".

4.1.2. Frequency of the use of Internet applications for business purposes

In Table 2, the user frequency of several Internet applications for business purposes is grouped according to the five dimensions resulting from the Principal Component Analysis, as described above. In the table for each group and each application the percentage of respondents that never use it is shown, as well as the percentage of respondents that use it regularly to frequently (scores

Table 2
Frequency of the use of Internet applications.

Internet applications	Never (%)	Regularly or more (%)	Mean Likert score
Basic management information			
Information on prices of plant protection products	62	23	1.69
Information on prices of fertilisers	71	14	1.48
Information on prices of installations and machinery	39	35	2.21
Information on technologies that reduce environmental impact	68	10	1.48
Information from government	50	21	1.81
General management information	45	26	1.90
Specialised management information			
Paid websites on horticulture	77	13	1.48
Information on techniques to reduce fertilisers use	79	7	1.30
Information on techniques to reduce use of plant protection products	75	11	1.40
Information on recruitment of personnel	74	12	1.47
E-commerce			
E-commerce: publicity for own products	82	13	1.44
E-commerce: selling of outputs	90	5	1.20
Promotion and advertisement on Internet	85	6	1.27
E-commerce: buying of inputs	85	6	1.26
Information on outputs			
Information on output yields	48	42	2.51
Information on output prices	31	60	3.09
General applications			
Weather forecasts	44	48	2.55
Online banking	12	86	4.20
Warning systems for diseases	49	37	2.23
Information from research institutes	53	28	1.93

3–5 on the Likert scale). The last column of the table contains the mean Likert scores.

The mean Likert scores for consulting basic management information through the Internet are quite low.

The scores are lower than 2 for collecting information on prices of plant protection products and fertilisers. Sixty-two percent and 71% of the respondents never look online for information on prices of plant protection products or fertilisers, respectively, while only 23% and 14% use it regularly or frequently for this purpose, respectively. Searching for information on prices of installations and machinery received a slightly higher average score (2.21), which may be explained by the higher cost of these purchases. Thirty-nine percent of the respondents never seek this information online, while 35% do so regularly or frequently. These percentages are lower than those obtained by Smith et al. (2004), who found that more than half of the farmers who use the Internet for business purposes search online for price information of inputs. The other information sources in the “Basic management information” group also had average Likert scores lower than 2. Despite the growing demand for environmentally sound production techniques, information searches for technologies that reduce environmental impact only scored 1.48. Sixty-eight percent of the respondents never use the Internet for this purpose, while only 10% use it regularly or frequently. It is interesting to note that half of the horticultural growers that use the Internet for business purposes never consult government information online. Only 21% of them use the Internet regularly or frequently to consult government information. The Internet is seldom used to find general management information. The average Likert score for this application is only 1.90; 45% of the respondents never use the Internet for this purpose, while 26% use it regularly or frequently.

Although the mean Likert scores for seeking basic management information on the Internet are low, scores are even lower for seeking specialised management information. The mean scores of the applications in this group are all below 1.5. Paid websites on horticulture are not in high demand: 77% of the respondents never use them, while only 13% use them regularly or frequently. Three-quarters of the horticultural growers in the survey never seek information online for ways to decrease the use of fertilisers or plant protection products. The Internet is never used to consult information on recruitment of personnel by 74% of the respondents, while 12% use it regularly or frequently for this purpose.

The average Likert scores for the various e-commerce applications are lower than 1.5. More than 80% of the growers have never used e-commerce to create publicity for their own products, to sell outputs, to promote or advertise their business, or to purchase inputs. It is clear that e-commerce is not yet a success in Flemish horticulture, which concurs with results of researchers in other countries (e.g. Ross and Waksman, 2001).

Compared with the applications mentioned above, using the Internet to obtain information on outputs is more common, especially on output prices. Seeking information on yields received an average Likert score of 2.51, while seeking information on output prices scored 3.09. Forty-eight percent and 31% of the respondents never or seldom uses the Internet to find information on yields or output prices, respectively, while 42% and 60% use it regularly or frequently, respectively. The importance of the Internet for consulting information on market prices and yields has also been observed by other researchers (e.g. Smith et al., 2004; Michailidis, 2006).

Among the general applications, online banking is the most popular. The average score for this application is 4.20, indicating that many horticultural growers that use the Internet for business purposes frequently use this application. Only 12% of the respondents indicate that they never use online banking, while 86% use it regularly or frequently. This result is in accordance with the findings of other researchers (e.g. Warren, 2008). Internet bank-

ing can be extremely beneficial to consumers by providing cost and time savings, reduced dependency on time and location, quick responses to complaints, more service variety and improved quality of service (Shi et al., 2008). Online banking can also reduce interest and bank charges (Warren, 2008), be more convenient, and reduce the number of trips to town (Michailidis, 2006). Consulting weather forecasts is another popular Internet application, used by almost half of the respondents. The mean Likert score for consulting weather forecasts is 2.55; 44% of the respondents never use this application, while 48% use it regularly or frequently. Average Likert scores lower than 2.5 are obtained for warning systems for diseases (2.23) and information from research institutes (1.93). Warning systems for diseases through Internet are never used by 49% of the horticultural growers, while 37% use it regularly or more frequently. It is important to note that more than half of the respondents never use the Internet to consult information from research institutes, while only 28% consult this information regularly to frequently.

In general, these results show that Flemish horticultural growers make low use of Internet applications, with the main exception being online banking. Internet use for seeking information is very limited. The online information sources used most frequently by horticulturists are information on market prices, yields of outputs, and weather forecasts. According to Offer (2005) researchers have spent years trying to work out exactly what information farmers need: there is now clear evidence that farmers will benefit most from frequently updated, rapidly changing information on prices, market reports, and the weather. The importance of the Internet for delivering weather information and information on commodity markets was also found by Smith et al. (2004) in their study on computer and Internet use by Great Plains farmers. This information can be used for better operational management decisions, although it was found by some researchers (e.g. Michailidis, 2006) that farmers who use the Internet primarily for consulting market prices and weather forecasts are also most likely to assign a low value to Internet use.

The Internet is seldom used for consulting basic and specialised management information. This could be related to the low priority given to management activities, including searching for information to support management decisions. This was confirmed by Taragola et al. (2002), who found that the average Belgian glasshouse grower makes low use of external information sources for production decisions. It is important to recall that many horticultural producers are not only decision-makers but are also involved in operational activities (Taragola et al., 2004). This is particularly the case in small companies, where time limitations negatively affect management activities. According to Iddings and Apps (1990), farmers express fear that management activities involving the computer take too much time from important outdoor activities, and thus are perceived to reduce profits. These sentiments seem exacerbated by a distaste for management activities. Furthermore, Warren (2002a) suggested that time constraints are perhaps the most significant roadblock to ICT use: in many places in Europe, a farmer's day is already filled by manual work. Staring at a computer screen after a long, hard day's work outside is not an attractive proposition. Öhlmer (2001) stresses that farmers often focus on short-term “intuitive” decisions based on their experience.

Another factor that limits ICT adoption in agriculture and horticulture is “lack of computer literacy” (Gelb et al., 2004; Taragola and Gelb, 2005; Gelb and Parker, 2005; Gelb, 2008). However, one can expect that the “lack of computer literacy” will decrease in the near future. Most of the younger horticultural producers are well-educated and have learned how to use computers and the Internet at school. Besides this technical proficiency, also the perception of the benefits of Internet use will remain important. Horticultural growers who are convinced of the economic benefits will allocate

the necessary time for it. Indeed, the most limiting factor cited by horticultural growers who do not use their PC for business purposes is “the lack of understanding how to get a benefit from the various ICT options” (Taragola and Van Lierde, 2007a). This was also confirmed by the scientists of the EFITA conferences, who indicated a shift from ICT technical proficiency as a limiting factor to the lack of understanding how to benefit from the various ICT options (Gelb et al., 2004; Gelb and Parker, 2005; Gelb, 2008). Offer (2005) shared the notion that lack of perceived benefit to the user is the fundamental hindrance to ICT adoption in agriculture. If the benefit of using software is greater than the effort required, adoption will occur; if the benefit is lower than the effort, it would not be used. Effort may be defined as time, intellectual input and cost, while benefit tends to be monetary. A refinement of this rule is to define benefit as “value”, and this value must be the value to the user, rather than a scientific or theoretical value which may be difficult to realise. It appears that horticultural growers are not sure as how the Internet can best be used to create value in their business. Enhancing horticultural growers' Internet use may require convincing them that both business management and information are important to improve business performance and competitiveness.

4.2. Personal and structural characteristics

4.2.1. Construction of the social characteristic variables

The objective of this research is to investigate the influence of personal and structural characteristics on the use of different Internet applications. Personal characteristics are subdivided into biographical characteristics, social characteristics and communication behaviour. Social characteristics that are expected to be important are the attitudes towards risk, environmentally friendly production and openness of the firm manager. These were determined by proposing a number of theses to the manager for each of the three attitudes. An overview of the theses can be found in Appendix A.

The manager was asked to score each thesis according to a Likert scale from 1 (not important) to 5 (very important). The score for each of the three attitudes was obtained by summation of the scores of the individual theses. In order to test the reliability of the summated scale the internal consistency reliability was verified using

Cronbach's alpha. As stated above, a value of 0.6 or less generally indicates unsatisfactory internal consistency reliability (Malhotra, 1999). The Cronbach's alpha value was 0.65 for the attitude of openness of management, 0.80 for the attitude towards risk and 0.77 for the attitude towards environmentally friendly production, which indicates that the internal consistency reliability is sufficient.

4.2.2. Reduction of the explaining variables

In total, 16 variables were used to explain the use of the five groups of Internet applications. Given that the number of explaining variables is rather high, and that many of these variables are correlated, categorical principal component analysis (CATPCA) was used to reduce these variables. The CATPCA analysis resulted in a reduction of the variables to 5 dimensions. The loadings of these components are listed in Table 3.

The five resulting dimensions are described below:

- Dimension 1 represents a socially open manager who actively searches for information. The variables with a high loading on this dimension are: attitude towards openness; attendance at seminars, demonstrations, excursions, and meetings of extension services; consultation of agricultural magazines, information sources, and persons and/or authorities; and membership in a horticultural society, study group or working group. This dimension accounts for 21.06% of the variance.
- Dimension 2 relates to the long-term perspectives of the business. The variables with a high loading on this dimension are: age of the manager (negative), education level of the manager, and presence of a successor. This dimension explains 13.34% of the variance.
- Dimension 3 relates to the characteristic of risk-avoidance and a negative attitude towards environmentally sound production. The variables with a high loading on this dimension are: attitude towards risk (negative) and attitude towards environmentally friendly production (negative). This dimension accounts for 8.84% of the variance.
- Dimension 4 represents larger businesses and their managers' search for specific advice. The variables with a high loading on this dimension are: use of paid extension services, number of additional courses of the manager (negative) and the economic dimension. This dimension accounts for 7.91% of the variance.

Table 3
Factor loadings for the principal components of personal characteristics of the manager and business characteristics.

Variables	Dimension				
	1	2	3	4	5
Biographical characteristics					
Age of manager	−0.150	−0.884	−0.067	0.026	0.018
Education level of manager	0.230	0.522	0.419	−0.191	−0.120
Education in agricultural or horticultural school	0.194	−0.103	0.335	−0.024	0.548
Number of additional courses of the manager	0.057	0.282	−0.045	−0.516	0.308
Presence of successor	0.125	0.804	−0.144	−0.098	−0.180
Social characteristics					
Openness (attitude)	0.670	0.103	−0.376	0.108	0.297
Risk (attitude)	0.452	0.245	−0.479	0.197	0.116
Environmentally friendly production (attitude)	0.375	−0.080	−0.610	−0.144	0.282
Communication behaviour					
Seminars, demonstrations, excursions, meetings of extension services	0.641	−0.246	0.151	−0.228	−0.052
Consulting agricultural magazines	0.608	−0.109	0.406	0.056	0.151
Consulting sources of information	0.708	−0.278	−0.076	−0.116	−0.379
Consulting persons, authorities	0.574	−0.221	−0.077	−0.215	−0.468
Paid extension services	0.170	0.217	0.150	0.721	0.027
Membership in a horticultural society	0.525	−0.107	0.220	0.130	0.378
Membership in a study club or working group	0.641	−0.246	0.151	−0.228	−0.052
Business characteristics					
Economic dimension	0.361	0.020	−0.055	0.470	−0.265
% of variance explained	21.06	13.34	8.84	7.91	7.70

Factor loadings in bold are >0.45.

Table 4

Influence of the five dimensions of personal and business characteristics on the use of different Internet application (regression analyses).

Variables	Basic management information		Specialised management information		E-commerce		Information on output prices and yields		General applications	
	Standard. regression coefficient	Statistical sign. <i>p</i> -value	Standard. regression coefficient	Statistical sign. <i>p</i> -value	Standard. regression coefficient	Statistical sign. <i>p</i> -value	Standard. regression coefficient	Statistical sign. <i>p</i> -value	Standard. regression coefficient	Statistical sign. <i>p</i> -value
Dimension 1: Openness and active search for information	0.322	0.000***	0.359	0.000***	0.098	0.197	0.206	0.009***	0.395	0.000***
Dimension 2: Long-term perspectives of the business	0.045	0.554	−0.048	0.518	0.142	0.064*	−0.070	0.369	0.148	0.042**
Dimension 3: Negative attitude towards risk and environmentally friendly production techniques	−0.051	0.504	−0.016	0.829	−0.196	0.011**	−0.126	0.105	−0.083	0.253
Dimension 4: Larger business size with the search for specific advice	0.016	0.835	0.148	0.046**	0.128	0.093*	−0.041	0.593	0.064	0.375
Dimension 5: Agricultural and horticultural education supplemented by additional courses	0.001	0.986	−0.025	0.734	0.155	0.042**	−1.170	0.244	−0.083	0.249
<i>N</i>		163		163		163		163		163
<i>R</i> -squared		0.11		0.15		0.11		0.07		0.20
Adjusted <i>R</i> -squared		0.08		0.13		0.08		0.04		0.17
Model <i>F</i> statistic		3.79***		5.63***		3.78***		2.44**		6.70***

* Coefficients that are different than 0 at the 0.10 level of probability.

** Coefficients that are different than 0 at the 0.05 level of probability.

*** Coefficients that are different than 0 at the 0.01 level of probability.

- Dimension 5 has a high factor loading on agricultural or horticultural education, which is supplemented by additional courses. This dimension explains 7.70% of the variance.

4.2.3. Influence of personal and structural characteristics on the use of Internet applications for business purposes

For each of the five groups of Internet applications, the Internet use score was calculated by summation of the Likert scores of each application within the group. This score was then used as a dependent variable in the regression analyses, measuring the influence of personal and structural characteristics on the use of the five groups of Internet applications. The results of the regression analyses are presented in Table 4.

• Group 1: Basic management information

The results of the regression analysis indicate a significantly positive influence of Dimension 1 (openness and active search for information) on Internet use to find basic management information. No significant influence is found for the other dimensions.

These findings indicate that Hypothesis 1, which assumes a relation between the use of Internet and personal characteristics of the business manager, can only partially be accepted. The positive influence of openness and open communication behaviour on Internet use was expected. Also for education and a positive attitude towards risk and environmentally sound production techniques, a positive influence was expected. However, no significant effect was found for these characteristics. The expected negative influence of age could also not be confirmed.

Hypothesis 2, which relates to business characteristics, assumes that business size will be positively related to the use of Internet applications. Although many researchers found that farm size was positively related to the attitudes towards, and the use of information sources (Ford and Babb, 1989; Schnitkey et al., 1992; Ortmann et al., 1993), this hypothesis could not be confirmed for using the Internet for searching basic management information.

The results reveal that the attitude of the business manager towards openness and active search for information is an important indicator for Internet use to find basic management information.

• Group 2: Specialised management information

Analogous to the results listed above, a significant positive influence of Dimension 1 (openness and active search for information) is found on Internet searches for specialised management information. No significant influence is detected for Dimension 2 (long-term perspectives of the business), Dimension 3 (negative attitude towards risk and environmentally sound production techniques) and Dimension 5 (agricultural or horticultural education, supplemented by additional courses). Although no significant influence is found of Dimension 4 (larger business size with the search for specific advice), this dimension shows a significantly positive influence on Internet use to find specialised management information.

The results reveal that Hypothesis 1, which assumes a relationship between the personal characteristics of the firm manager and Internet use, can also partially be accepted for seeking specialised management information online. The assumptions of the positive influence of education, a positive attitude towards risk and environmentally sound production, and a negative influence of age, are not confirmed by the results. The positive effect of the attitude towards openness and demonstration of open communication behaviour, which were found to have a positive and significant influence on Internet use when seeking basic management information, can also be confirmed when seeking specialised management information.

These results indicate that managers with active search behaviour also have a higher probability of seeking specialised management information online.

A difference with the above-mentioned results is that Hypothesis 2 is confirmed in the case of using the Internet for seeking specialised management information. Dimension 4 (larger business size with the search for specific advice), was found to be a positive and significant influence on the online searches for specialised management information. One reason why business size might be related to Internet searches for specialised management information is that large companies should be able to derive a greater benefit from this type of information. Also, certain types of specialised management information, such as information on personnel recruitment, will be more useful for larger companies because of their higher employment rate. In the case of paid horticultural websites, larger firms are more likely than smaller ones to benefit more from the costs of acquiring this type of information.

• Group 3: E-commerce

Unlike the other Internet applications, no significant relation is found between Dimension 1 (openness and active search for information) and the use of e-commerce. The results show a statistically weak positive influence for Dimension 2 (long-term perspectives of the business) and Dimension 4 (larger business size with the search for specific advice). The influence of Dimension 3 (negative attitude towards risk and environmentally friendly production techniques) is found to be significantly negative. This means that companies with a risk-averse manager who has a negative attitude towards environmentally friendly production methods will have a lower probability of using e-commerce applications, and vice versa. The results indicate that Dimension 5 (agricultural and horticultural education, supplemented by additional courses) has a statistically positive impact on the use of e-commerce.

Based on these results, Hypothesis 1, which assumes an influence of the personal characteristics of the business manager on Internet use, can be partially accepted. The expected positive influence of education is confirmed. The positive relation between the dimension “long-term perspectives of the business” and the use of e-commerce suggests that age is negatively related to the use of e-commerce. The variables with a high loading on this dimension are: age of the manager (negative), education level of the manager, and presence of a successor. One can assume that the higher probability of using e-commerce for the younger and better-educated business managers, or managers with a successor, is related to their greater familiarity with the use of computers. Although a positive effect of the attitude towards openness and communication behaviour was expected, no significant influence of this dimension on the use of e-commerce can be detected. This result indicates that e-commerce is a special type of Internet application, one that can clearly be distinguished from the other applications that focus on the search for information. As expected, the dimension “negative attitude towards risk and environmentally sound production techniques” is found to have a significant negative influence on the use of e-commerce. The reverse is also true: a positive attitude towards risk and environmentally sound production techniques should have a significantly positive influence on the use of this application. The importance of the risk factor in evaluating on line applications was also stressed by Lu et al. (2005), who found that the perceived risk has an impact on the intentions to use an online application. Trust and risk perception also were found to have an impact on the adoption of e-government services (Bélanger and Carter, 2008).

Hypothesis 2 states that there will be a positive influence of business size on the use of Internet applications. In the case of e-commerce the results give evidence of a statistically weak posi-

tive influence of Dimension 4 (larger business size with the search for specific advice). One can assume that for larger businesses, the perceived benefits of e-commerce are higher.

• Group 4: Information on output prices and yields

The results from the regression analysis on online searches for information on output prices and yields are comparable to those for Internet searches for basic management information. Only for Dimension 1 (openness and active search for information) a statistically significant positive influence is found. This finding indicates that companies with a socially open manager who actively searches for information do have a significantly higher use of Internet applications where they can find information on output prices and yields. No significant influence is found for the other dimensions.

For both hypotheses the same conclusions can be drawn as for using the Internet for seeking basic management information.

• Group 5: General Internet applications

Analogous to the results of the other regression analyses (except e-commerce), Dimension 1 (openness and active search for information) shows a significantly positive influence on the use of general Internet applications. Contrary to most of the other Internet applications, Dimension 2 (long-term perspectives of the business) emerges as a significantly positive factor. This indicates that younger and better-educated managers or businesses with a successor, who are assumed to be more familiar with computer and Internet use, do have a higher probability of using general Internet applications, such as online banking and weather forecasts. This dimension also showed a weakly significant positive influence on the use of e-commerce. No significant influence is found for the other dimensions.

Hypothesis 1, assuming a relation between the personal characteristics of the business manager and Internet use, is partially confirmed for the general Internet applications. The statistically significant positive influence of Dimension 1 (openness and active search for information) and Dimension 2 (long-term perspectives of the business) confirm the positive influence of education and the negative influence of age of the business manager. However, specific agricultural or horticultural education does not show any effect. The positive effect of a positive attitude towards openness and active search for information can be confirmed. No confirmation is found for the expected negative impact of a negative attitude towards risk and environmentally friendly production techniques.

The positive effect of business size, which was assumed in Hypothesis 2, is not confirmed for the general Internet applications. One can thus conclude that the personal characteristics of the firm manager seem to be more important in explaining the use of general Internet applications than business size.

5. Conclusion

The average Flemish horticultural grower makes low use of Internet applications. A notable exception is home-banking, which can be important in terms of time and cost saving, convenience, reduction of interest and bank charges, and so on. Flemish horticultural growers make very limited use of the Internet when seeking information. The most important information sources consulted via Internet are information on market prices, yields of outputs, and weather forecasts. This finding is confirmed by other researchers; it was also found that farmers who use the Internet primarily for consulting market prices and weather forecasts are most likely to put a low value on Internet use (e.g. Michailidis, 2006). The Internet is seldom used when searching for basic and

specialised management information. This can be related to the low priority given to management activities, particularly in small companies, where time constraints managers' work activities. The results also reveal that e-commerce is not yet a success in Flemish horticulture. More than 80% of the growers have never used e-commerce to create publicity for their own products, to sell outputs, for promotion and advertising through the Internet, or to purchase inputs.

Internet adoption can only be stimulated if one knows which factors influence the use of various Internet applications. Hypothesis 1, which assumes an influence of the personal characteristics of the business manager, is confirmed for most applications, but not all characteristics are equally important for every application.

The dimension "openness and active search for information" shows a significant positive influence for all examined Internet applications, except e-commerce. One can assume that managers who demonstrate open communication behaviour are convinced that seeking information is important for making better management decisions. The dimension "long-term perspectives of the business" shows a significantly positive effect on the use of general applications. This dimension is also weakly significant for the use of e-commerce. This means that the probability of using these applications is higher for younger and better-educated business managers or companies with a successor. Unlike Internet applications that focus on the search for management information, the general Internet applications such as online banking and consulting weather forecasts are more related to the daily or operational activities of the business manager. Here, one can assume that the higher probability of Internet use among the younger and better-educated business managers or managers with a successor, is related to their greater familiarity with the use of computers. The dimension "negative attitude towards risk and environmentally friendly production techniques" has a significantly negative influence on the use of e-commerce. This means that companies with a risk-averse manager with a negative attitude towards environmentally friendly production methods will have a lower probability of using e-commerce applications, and vice versa. The dimension "agricultural or horticultural education, supplemented by additional courses" shows no significant influence on the use of the examined Internet applications, except for e-commerce. Here again, the positive effect of education on the use of e-commerce comes at the forefront.

Hypothesis 2, which assumes a positive influence of business size on the use of the different Internet applications, is only confirmed for searching for specialised management information, along with a weakly significant positive influence on e-commerce. One reason why business size might be related to searching the Internet for specialised management information and engaging in e-commerce is that large companies should derive a greater benefit from these Internet uses due to the influence of scale effects.

These results reveal that for many applications, the attitudes of the business manager greatly influence Internet use. Managers with open communication behaviour and who actively search for information do have a higher probability of using the Internet to find information. Information contributes to efficiency when it helps horticultural growers make better decisions and manage risk. This evidence is also consistent with Iddings and Apps' (1990) claim that enhancing farmers' performance may require convincing farmers that management and information are important. It appears that horticultural growers are not sure how the Internet can best be used to create value in their business. Development of human capital is essential to increase the speed and coverage of Internet adoption. Stimulation of basic introductory educational programmes targeted towards small businesses and less-educated business managers (e.g. basic IT skills, Internet search techniques), and more advanced programmes for the well-educated business managers, will likely be important. Due to the effect of learning, we

can assume that horticultural growers will find the Internet more useful as they spend time using it and discover where the benefits lie.

Attempts to enhance horticulturists' performance by encouraging the use of Internet require more attention to their specific needs rather than just providing general formal education. Horticultural growers will be more likely to use the Internet as they gain experience with it. Various professional organisations in Flanders already present educational programmes for producers, but the majority of the horticultural growers do not attend them. Those who sign up for the educational programmes are the ones who are already open and aware of the importance of information to improve business performance. Perceived benefits of Internet use will likely increase in the future: more horticultural growers move up the adoption curve, the technology will become more applicable to horticultural businesses, and new applications and services will become available. It is particularly important that horticultural growers, and farmers in general, perceive Internet use as an added value for their businesses. Further research tracking these changes and better identification of the benefits of Internet use will increase the understanding of how Internet use will influence the competitiveness of Flemish horticulturists.

Appendix A. Measurement of attitudes

Attitude towards openness

- AO 1. It is important to invite people from outside the horticultural industry to your business.
- AO 2. Sometimes, it is necessary to consult professional advisors before making a decision.
- AO 3. It is important to be informed of agricultural and horticultural policies.
- AO 4. New technologies/ideas are usually an improvement compared to traditional technologies/ideas.
- AO 5. Modern accountancy systems are important in horticulture.
- AO 6. Sometimes I visit other horticultural businesses to observe their management and production methods.
- AO 7. It is important to read about horticulture.
- AO 8. I frequently introduce changes in my business (cultivation technique, business management) to improve my results.
- AO 9. I am open to collaboration with other colleagues/gardeners.

Attitude towards risks

- AR 1. I like to experiment and try new things in order to see if I can get better results.
- AR 2. Compared to my colleagues/gardeners I am an early adopter of new technologies.
- AR 3. Good business management implies occasionally taking calculated risks.
- AR 4. In the past years I have taken several risks by trying out new things.
- AR 5. I consider applying new techniques to my business that are technically feasible but very risky.

Attitude towards environmentally sound production

- AE 1. It is important that the use of chemical pesticides in horticulture will be reduced.
- AE 2. It is important to explore new methods that allow for less pesticide use.
- AE 3. It is important to explore new methods that allow for reduction of pollution by fertilisers.

- AE 4. It is important to develop new techniques that allow for reduction of the environmental pressure of horticultural production.
- AE 5. By producing in an environmentally friendly way I can actually do something to improve the environment.
- AE 6. In my business I already make a maximum effort to minimise the use of chemical pesticides.
- AE 7. For the grower environmentally friendly production only means extra costs (-).
- AE 8. Environmentally friendly production must be further expanded.
- AE 9. Modern horticulture is too strongly based on the use of chemical pesticides.
- AE 10. Environmentally friendly production always results in lower profitability (-).
- AE 11. Excessive use of fertilisers has a negative impact on the environment.
- AE 12. Producing with the lowest possible environmental pollution is a major concern.
- AE 13. In the future of my company, environmentally sound production will be important.

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